

# Factors in Diagnosis and Classification of Deaths from CVR Diseases

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OVER one-half of the deaths occurring annually in the United States are attributed to cardiovascular-renal diseases (CVR). As may be seen from table 1, the largest frequency of deaths is found in the component arteriosclerotic heart disease including coronary disease. Next in frequency are vascular lesions affecting the central nervous system, and the hypertensive diseases. With the decline in mortality from infectious diseases generally, cardiovascular diseases of infective origin now constitute less than 5 percent of the total CVR disease mortality.

Marked differences in death rates appear for the various demographic characteristics as well as geographic areas. The reasons for these differences are not all clear. Nor is there agreement that the recorded differences are real. Some feel that the problems of diagnosis, reporting, and classification of these diseases are of such a nature that no valid assessment of mortality trends and differentials is possible. Others feel that despite the shortcomings of the data, mortality statistics provide useful indicators of the general trend and magnitude of CVR disease mortality. This disagreement is rooted in the lack of quantitative information with respect to these problems.

Various factors complicate the interpretation of CVR disease mortality statistics. First, there is the question of the reliability of the

diagnostic data on which the medical certification of causes of death is based. There are several facets to this problem. The prevailing concept of disease and diagnostic criteria of the day provide the background for medical practice. The amount and quality of diagnostic evidence available to the medical certifier, and the diagnostic acumen of the attending physician determine the quality of diagnosis made. At this point, it should be recognized that diagnoses are judgments arrived at after a study of available clinical and pathological observations. Even with standard diagnostic criteria, it is highly unlikely that absolute accuracy in diagnosis will ever be possible for diseases of the CVR system because of the varying medical backgrounds and experience of the relatively large population of physicians.

There can be no question that over the years there has been a great increase in knowledge with resultant changes in the concept of cardiovascular-renal diseases. The development of diagnostic criteria and techniques and improvements in diagnostic facilities and methods have undoubtedly influenced cardiovascular-renal disease mortality statistics. For example, the diseases of coronary arteries which today are the most important component of the CVR disease complex were not reported with any great frequency as a cause of death until about 1926. Halsey, cited by Hedley (1) and Atlanson (2), has pointed out that there has been a change in emphasis in the diagnosis of heart disease away from valvular to myocardial diseases and more particularly to the coronary vessels which supply the myocardium. Levy's review (3) of the clinical and pathological rec-

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**Table 1. Number of deaths and death rates for the components of major cardiovascular-renal diseases, United States, 1956**

| Major cardiovascular-renal diseases                             | Number of deaths | Rate <sup>1</sup> | Percent |
|---|------------------|-------------------|---------|
| Total.....  | 854, 152         | 510. 7            | 100. 0  |
| Vascular lesions affecting central nervous system.....          | 177, 845         | 106. 3            | 20. 8   |
| Rheumatic fever and chronic rheumatic heart disease.....        | 20, 029          | 12. 0             | 2. 3    |
| Arteriosclerotic heart disease, including coronary disease..... | 427, 516         | 255. 6            | 50. 1   |
| Other heart disease, except hypertensive....                    | 84, 090          | 69. 5             | 9. 8    |
| Hypertensive diseases.....                                      | 83, 341          | 49. 8             | 9. 8    |
| Other cardiovascular-renal diseases.....                        | 61, 331          | 17. 5             | 7. 2    |

<sup>1</sup> Rate per 100,000 estimated population.

ords of the New York Presbyterian Hospital for the period of 1920 to 1930 showed that although the incidence of coronary disease in the pathological records was fairly constant each year (10 to 12 percent) throughout the decade, there was an increase of 400 percent in the frequency of clinical diagnosis of various forms of coronary diseases. Levy states that "It was after the publication of the papers of Herrick in 1912 and again in 1919 that interest of the profession in this country was aroused in the problems of acute coronary obstruction, and in the succeeding years clinicians became more alert in recognizing the disturbance in the coronary circulation and recorded them more frequently."

Other significant changes in the concept of CVR diseases relate to the vascular changes caused by diabetes (4) and the possible etiological relationship between cholesterol and atherosclerosis. The role of hypertension and the effects of therapeutic procedures on hypertensives are beginning to be better understood. These developments have an impact upon the diagnosis of CVR diseases, but it is not possible to determine the extent to which the statistics on CVR disease mortality are influenced. Undoubtedly, however, data on the individual components of the CVR disease complex are significantly affected. On the other hand, most of the shifts are within the CVR system, and

mortality data for all CVR diseases are probably relatively free from complications resulting from these changes in concept.

A number of studies have explored the accuracy of cause-of-death statements on death certificates (5-7). On the basis of comparisons between clinical and pathological records, the diagnostic statements relating to CVR diseases have been found in these studies to be relatively poor. Those investigations which utilize autopsy findings as the standard of reference have serious limitations. For example, diagnoses of clinical entities cannot always be established by autopsy findings. In the study of James and associates (7), the use of autopsy data decreased the proportion of deaths attributed to such causes as diabetes and hypertensive diseases and increased the proportion attributable to arteriosclerosis.

Deaths of patients in hospitals tend to be weighted with surgical cases, acute illnesses, and diseases and conditions relatively difficult to diagnose. Pathological findings are sought more often for deaths where the clinical diagnosis is not clear or where diagnostic confirmation is desired. Thus, the selection of deaths in hospitals, particularly deaths for which autopsies were performed, should lead to greater disagreement than would appear in a hypothetical situation where cause-of-death statements are compared with clinical or pathological findings.

#### **Pennsylvania Study**

In order to avoid the selective factors involved in the study of hospital deaths that come to autopsy, the medical certifier was queried in a sample of death certificates issued in hospitals for a 3-month period in 1956 in Pennsylvania. The methodology and results of this study were published recently (8). Briefly, the method of study was to send a questionnaire to the physician signing the death certificate asking for information on diagnostic methods, the pertinent findings on which the medical certification of death was based, and an expression of his certainty of the diagnosis on the medical certification. The returns were reviewed by an internist and rated as to quality (type and amount) of supporting

**Table 2. Quality (type and amount) of supporting diagnostic information on cardiovascular-renal diseases, Pennsylvania mortality sample, 3-month period, 1956<sup>1</sup>**

| Major cardiovascular-renal diseases                            | Total number | Percent   |       |         |           |
|--|--------------|-----------|-------|---------|-----------|
|  |              | Very good | Good  | Sketchy | No report |
| Total.....   | 1, 406       | 28. 7     | 19. 8 | 47. 4   | 4. 1      |
| Intracranial lesions of central nervous system.....            | 254          | 20. 9     | 23. 2 | 51. 2   | 4. 7      |
| Rheumatic fever and rheumatic heart disease.....               | 41           | 58. 5     | 19. 5 | 14. 6   | 7. 4      |
| Arteriosclerotic heart disease including coronary disease..... | 692          | 29. 8     | 17. 6 | 49. 0   | 3. 6      |
| Other heart disease, except hypertensive disease.....          | 167          | 17. 4     | 16. 2 | 64. 1   | 2. 3      |
| Hypertensive diseases.....                                     | 150          | 30. 7     | 27. 3 | 36. 0   | 6. 0      |
| Other cardiovascular-renal diseases.....                       | 102          | 45. 1     | 21. 6 | 29. 4   | 3. 9      |

<sup>1</sup> Totals adjusted to number of deaths in current mortality sample.

diagnostic information and consistency of medical certification with the diagnostic evidence. Also, the reviewing internist rated his impression of certainty of the diagnosis.

The findings on CVR diseases may be summarized as follows:

1. A relatively large proportion (47 percent) of the available diagnostic information on CVR diseases was sketchy (table 2); in 20 percent, it was "good;" and in 29 percent, "very good." In 4 percent, there were no returns on which to make an assessment.

2. Analysis of evidence presented in 1,406 deaths in support of a diagnosis of the major CVR diseases judged the certified diagnosis most probable in 78 percent of the deaths, an-

other diagnosis equally probable in 14 percent, and a different diagnosis preferred in 3 percent (table 3). No diagnostic information was available in the remaining 4 percent. These figures may to some degree understate the quality of medical certifications of deaths from CVR diseases since judgments were made on the specific diagnoses reported. Some classified as "another diagnosis equally probable" or "another diagnosis preferred" could well have been the "most probable diagnosis" had the cause-of-death statement referred to another related disease within the cardiovascular-renal system. With respect to the specific diagnoses, the proportion of medical certifications judged to be the "most probable diagnosis" ranged from 67

**Table 3. Consistency of medical certification with diagnostic evidence on cardiovascular-renal diseases, Pennsylvania mortality sample, 3-month period, 1956<sup>1</sup>**

| Major cardiovascular-renal diseases                             | Total number | Percent                 |                                    |                             |                           |
|---|--------------|-------------------------|------------------------------------|-----------------------------|---------------------------|
|   |              | Most probable diagnosis | Another diagnosis equally probable | Another diagnosis preferred | No diagnostic information |
| Total.....  | 1, 406       | 78. 2                   | 14. 4                              | 3. 3                        | 4. 1                      |
| Vascular lesions of central nervous system.....                 | 254          | 85. 0                   | 8. 7                               | 1. 6                        | 4. 7                      |
| Rheumatic fever and rheumatic heart disease.....                | 41           | 82. 9                   | 9. 8                               | 0                           | 7. 3                      |
| Arteriosclerotic heart disease including coronary diseases..... | 692          | 78. 6                   | 16. 5                              | 1. 3                        | 3. 6                      |
| Other heart diseases, except hypertensive.....                  | 167          | 66. 5                   | 19. 8                              | 11. 4                       | 2. 3                      |
| Hypertensive diseases.....                                      | 150          | 76. 0                   | 16. 0                              | 2. 0                        | 6. 0                      |
| Other cardiovascular-renal diseases.....                        | 102          | 78. 4                   | 5. 9                               | 11. 8                       | 3. 9                      |

<sup>1</sup> Totals adjusted to number of deaths in current mortality sample.

percent for "other heart diseases, except hypertensive" to 85 percent for the vascular lesions affecting the central nervous system.

3. The reviewer's evaluation of the diagnostic information on deaths certified by physicians indicated that diagnosis was solidly established in 33 percent of the CVR deaths, and reasonably well established in 47 percent of the deaths (table 4). In other words, in 80 percent of the deaths from CVR diseases, the diagnoses were evaluated to be reasonable or better. There was more uncertainty concerning the accuracy of diagnoses of deaths from hypertensive diseases and the residual group of CVR diseases. The query form was probably weakest in eliciting clinical evidence which, in part, may account for the lower proportion of solidly established and reasonable diagnoses for these rubrics.

4. A relatively large proportion (15 percent) of deaths from CVR diseases in Pennsylvania was certified by the medical examiner or coroners. This proportion was much higher (31 percent) for coronary heart disease, which is frequently linked with sudden death. The care with which the medical examiner and coroners discharge their legal responsibilities can significantly affect statistics for CVR disease mortality. In Pennsylvania, at least, the coroners or medical examiner often consult the family physician, if there is one, before making out the medical certificate, or, if the reasons for death seem unclear, an autopsy is ordered.

5. The differences in diagnostic quality do

not appear to be important factors in the interpretation of sex and age differentials, in the more usual situation where the interest is in reasonable diagnosis or better.

6. Data by place of residence of the decedent showed slight differences by population size; but these do not seem large enough to account for much of the observed urban-rural differences in mortality.

7. There seemed to be a marked urban-rural difference in the quality of diagnoses according to the physician's place of practice. About 80 percent of the diagnoses of urban medical practitioners were rated as "solidly established" or "reasonable," while 70 percent of the diagnoses of their rural colleagues fell into those categories.

The establishment of an adequate diagnosis is important, but for the purposes of mortality statistics, diagnostic information must also be reported properly on the death certificate. This requires a complete statement of the judgment of the medical certifier on the sequence of events leading to death, in unambiguous medical terminology. Unless all of the pertinent facts are reported completely in the proper sequence, accurate and consistent classification becomes difficult.

In the Pennsylvania study, the diagnostic information on CVR diseases was reported "completely" by physicians on 84.7 percent of the death certificates (table 5). On 11.8 percent, the medical certification was incomplete in some respects. For example, an intervening

**Table 4. Reviewers' evaluation of diagnostic information on cardiovascular-renal deaths certified by physicians, Pennsylvania mortality sample, 3-month period, 1956<sup>1</sup>**

| Major cardiovascular-renal diseases                  | Total number | Percent                       |                      |                    |                          |
|--|--------------|-------------------------------|----------------------|--------------------|--------------------------|
|  |              | Solidly established diagnosis | Reasonable diagnosis | Diagnosis in doubt | Diagnosis probably wrong |
| Total.....   | 1, 194       | 32. 8                         | 46. 5                | 10. 3              | 6. 0                     |
| Vascular lesions of central nervous system.....      | 236          | 31. 8                         | 53. 8                | 7. 2               | 2. 1                     |
| Rheumatic fever and rheumatic heart disease.....     | 38           | 58. 0                         | 23. 7                | 7. 9               | 2. 6                     |
| Arteriosclerotic heart disease.....                  | 260          | 30. 0                         | 51. 9                | 9. 2               | 3. 5                     |
| Heart disease specified as involving coronaries..... | 271          | 39. 1                         | 45. 0                | 10. 7              | 3. 0                     |
| Hypertensive diseases.....                           | 128          | 32. 8                         | 40. 6                | 16. 4              | 3. 1                     |
| Other cardiovascular-renal diseases.....             | 261          | 26. 4                         | 42. 1                | 11. 1              | 17. 2                    |

<sup>1</sup> Total adjusted to number of deaths in current mortality sample. Deaths with no reported information are included in the total but not distributed in the percentages shown.

**Table 5. Percent completeness of medical certifications of cardiovascular-renal diseases, Pennsylvania mortality sample, 3-month period, 1956<sup>1</sup>**

| Major cardiovascular-renal diseases                             | Physicians' returns |          |            |                    |           | Medical examiner's and coroners' returns |          |            |                    |           |
|---|---------------------|----------|------------|--------------------|-----------|--|----------|------------|--------------------|-----------|
|   | Total number        | Percent  |            |                    |           | Total number                             | Percent  |            |                    |           |
|   |                     | Complete | Incomplete | Grossly incomplete | Incorrect |  | Complete | Incomplete | Grossly incomplete | Incorrect |
| Total.....  | 1, 142              | 84. 7    | 11. 8      | 1. 9               | 1. 6      | 206                                      | 70. 4    | 26. 2      | 1. 0               | 2. 4      |
| Intracranial lesions of central nervous system.....             | 224                 | 91. 5    | 7. 6       | 0                  | . 9       | 18                                       | 66. 7    | 33. 3      | 0                  | 0         |
| Arteriosclerotic heart disease including coronary diseases..... | 511                 | 88. 3    | 10. 6      | 0                  | 1. 2      | 156                                      | 67. 9    | 29. 5      | 1. 3               | 1. 3      |
| Other heart diseases, except hypertensive.....                  | 191                 | 72. 3    | 16. 8      | 9. 4               | 1. 6      | 10                                       | 100. 0   | 0          | 0                  | 0         |
| Hypertensive diseases.....                                      | 119                 | 87. 4    | 12. 6      | 0                  | 0         | 19                                       | 89. 5    | 10. 5      | 0                  | 0         |
| Other cardiovascular-renal diseases.....                        | 97                  | 71. 1    | 17. 5      | 4. 1               | 7. 3      | 0  | -----    | -----      | -----              | -----     |

<sup>1</sup> Totals do not include reports on which diagnostic information not received and not adjusted to number of deaths in the current mortality sample.

cause in the sequence of events was omitted. A few, 1.9 percent, were grossly incomplete. On 1.6 percent, the diagnostic information was judged to be reported incorrectly. As might be expected, the proportion of medical certificates completely reported by the medical examiner and coroners was lower (70.4 percent). However, the proportion adjudged grossly incomplete and incorrect did not differ significantly from that for reports by private physicians.

The reporting of sequence of events was

generally good, despite the difficulties involved in determining the relationship between the various components of CVR diseases. As may be seen in table 6, about 94 percent of the certifications of CVR diseases by physicians represented correct or substantially correct sequence. The terminology used was also generally good, except in the group categorized as "other diseases of the heart, except hypertensive." Here the persistent use of the obsolete term "chronic myocarditis" resulted in a high proportion of reports by certifying

**Table 6. Percent of cardiovascular-renal disease reported by physicians in proper sequence of events using good or bad terminology, Pennsylvania mortality sample, 3-month period, 1956<sup>1</sup>**

| Major cardiovascular-renal diseases                             | Total number | Correct sequence |       |       | Substantially correct |      |      | Incorrect sequence |      |      |
|---|--------------|------------------|-------|-------|-----------------------|------|------|--------------------|------|------|
|   |              | Total            | Good  | Bad   | Total                 | Good | Bad  | Total              | Good | Bad  |
|   |              |                  |       |       |                       |      |      |                    |      |      |
| Total.....  | 1, 142       | 90. 5            | 84. 1 | 6. 4  | 3. 4                  | 2. 5 | 0. 9 | 6. 0               | 5. 1 | 0. 9 |
| Intracranial lesions of central nervous system.....             | 224          | 94. 3            | 90. 2 | 4. 1  | 2. 2                  | 1. 8 | . 4  | 3. 6               | 3. 6 | 0    |
| Arteriosclerotic heart disease including coronary diseases..... | 511          | 89. 9            | 86. 0 | 3. 9  | 4. 5                  | 3. 5 | 1. 0 | 5. 7               | 4. 9 | . 8  |
| Other heart diseases, except hypertensive.....                  | 191          | 86. 6            | 67. 5 | 19. 1 | 5. 2                  | 3. 1 | 2. 1 | 7. 4               | 5. 8 | 1. 6 |
| Hypertensive diseases.....                                      | 119          | 92. 4            | 88. 2 | 4. 2  | 0                     | 0    | 0    | 7. 6               | 4. 2 | 3. 4 |
| Other cardiovascular-renal diseases.....                        | 97           | 91. 8            | 91. 8 | 0     | 0                     | 0    | 0    | 8. 2               | 8. 2 | 0    |

<sup>1</sup> Totals do not include reports on which diagnostic information not received, and not adjusted to number of deaths in current mortality sample.

physicians being cited by the reviewer as poor terminology. In Pennsylvania, the reporting of CVR diseases by medical examiner and coroners does not appear to present much of a problem. This may not be the case in other parts of the country.

The medical certifier provides the information which forms the basis of cause-of-death statistics. For statistical purposes this information is classified according to certain prescribed rules, by the current categories of the International Lists of Diseases and Causes of Death. For primary mortality tabulations, it is necessary to select a single cause which is presumably the disease or condition which initiated the train of events leading to death. In CVR diseases, the cause so selected is frequently modified by the special provisions in the classification. Thus, data on certain presumptive etiological factors are lost. For example, "cerebral hemorrhage due to hypertension" is classified as intracranial lesions of vascular origin, and the presence of hypertension does not appear in the tabulations.

The problems of classification have been described elsewhere (9-13). Aside from the difficulties in adequately characterizing the diseases of the CVR system by selecting a single underlying cause, the decennial revisions of the international lists limit severely the compilation of a comparable series of statistics for the specific components of the CVR diseases. However, in view of the fact that revisions of the classification generally entail further subdivisions of CVR diseases and transfers within the CVR system, comparability of statistics for all CVR diseases has not been affected materially over the years.

## Conclusions

The situation with respect to the interpretation of CVR disease mortality statistics in the United States appears to be as follows:

1. Available data on the accuracy of diagnosis and of medical returns on death certificates are fragmentary and have certain limitations. The relative dearth of good supporting diagnostic information appears to be a problem in CVR mortality, but the Penn-

sylvania study suggests that the quality of diagnosis as reported on death certificates is for the most part reasonably good or better.

2. The universal adoption of diagnostic criteria such as those of the New York Heart Association (14) would materially improve the diagnostic information on death certificates. However, absolute and unflinching accuracy of diagnoses is unattainable. The etiological and pathological relationships in CVR diseases are often complex, and there is little opportunity for the medical certifier to make a thorough antemortem examination in a large proportion of deaths, say from coronary disease, because the patient dies suddenly.

3. Despite the various shortcomings of mortality data for the specific components of CVR diseases, data for the total complex of CVR diseases appear reliable for interpretation of mortality trends. More information is needed on a national scale and further work should be done to explore the factors of geographic distribution.

4. Because of the periodic revisions in classification, the study of the course of mortality of the components of CVR diseases will have to be limited necessarily to short-run analyses.

5. There should be a more general recognition that mortality data are not precise measures, but that in epidemiological studies they are useful in suggesting leads to be elaborated by other study approaches.

6. Preparatory work is now underway for the 8th revision of the International Lists of Diseases and Causes of Death. It is expected that the classification will provide for a greater number of disease complexes in the section on diseases of the CVR system. This will eliminate some of the troublesome factors in satisfactorily characterizing CVR diseases now encountered in primary mortality tabulations. However, it will not be possible to identify all the significant relationships. For this purpose, there will be a need for multiple-cause tabulations.

7. There has been a growing interest in studies of CVR disease mortality on an international scale involving various ethnic groups, in order to identify some of the etiological factors. A study group of the World Health

Organization is now developing diagnostic criteria for international use. Continuing interest in this area should be helpful in improving CVR disease mortality statistics.

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### World Health Day, April 7

The theme of World Health Day 1960, observed each year on April 7, is "Malaria Eradication—A World Challenge."

The Public Health Service will supply, upon request, program materials and background information on the World Health Organization, the history and current status of malaria throughout the world, and the progress which has been made in the worldwide malaria eradication effort. The Public Health Service also has an International Health Speakers' Bureau which includes prominent individuals throughout the United States who have been active in international health affairs and who have indicated their willingness to speak on World Health Day programs.

Requests for this material, or for other specific information about international health organizations or United States participation in international health programs, should be directed to the Assistant to the Surgeon General for International Health, U.S. Public Health Service, Department of Health, Education, and Welfare, Washington 25, D.C.

April 7 is the anniversary of the day on which the World Health Organization came into being. WHO, established in 1948, is one of the specialized agencies of the United Nations, with membership of 90 countries.